Mangalore University

PhD (Speech and Hearing)

Synopsis

PERCEPTION OF MUSIC AND SUPRASEGMENTAL FEATURES IN COCHLEAR IMPLANTEES

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Guide,
Dr. T. A. Subba Rao
Professor & PhD Guide
Dr. M.V. Shetty College of Speech & Hearing,
Malady court, Kavoor,
Mangalore- 575015.

Ph.D Scholar,
Pradeep V R
Research Scholar
Dr. M. V. Shetty College of Speech & Hearing,
Malady court, Kavoor,
Mangalore- 575015.

Chairman
Dr Satish K
Professor and Principal
Dr. M.V. Shetty College of Speech & Hearing,
Malady court, Kavoor,
Mangalore- 575015

Introduction

Speech perception can be described as a mode of hearing specialized for speech. When people engage in conversation, they do not hear simply the information conveyed in a waveform or a spectrogram. Instead, they perceive linguistic and indexical information that conveys words and sentences as well as identifying qualitative characteristics of the talkers. People are able to extract linguistic and indexical information from speech because of the specialized way the human hearing instrument is tuned. Accordingly, the study of infant speech perception is concerned with the tuning of that instrument during early development (Houston & Bergeson, 2014).

Cochlear Implant can partially restore hearing in patients with severe to profound sensory hearing loss. However, the large outcome variability in CI users prompts the need for more objective measures of speech perception performance. For a cochlear implant user to obtain a high level of speech perception the electrical stimulation, controlled via the speech processing strategy, must be adjusted or 'fitted' for each individual user. It is the task of the audiologist to fit the CI so that the user obtains the maximum level of speech perception. However, a number of factors make this a difficult task, which may result in less optimal fitting for that individual user. Currently, the audiologist adjusts the speech processing strategy and ask the users if it 'sounds better' or carries out a speech perception test. This subjective assessment of speech perception is less than optimal (Laughlin, Reilly & Zeng, 2013).

The cochlear implant surgery is relatively new entrant in the country. The first surgery was carried out in 1994. About one in 1000 babies born in India is profoundly deaf (≥90 dB in better ear). So, given the nearly 40,000 births in the country per day, the number of fully deaf children would be incredibly high. The available treatment for these children and other profound hearing-impaired individuals is the cochlear implant surgery. Though the implants have existed in India for long, usage is minuscule because of the high costs. Around

7% of the population of India suffers from profound deafness. More than a million children need either hearing aid or cochlear implant surgery to restore hearing. Still only 5000 cochlear implant surgery has been conducted in the country, the first being nearly 20 years ago, and most of them in private health facilities where the patient paid out of their pocket (Garg, Singh, Chadha & Agarwal, 2011). No studies have attempted to study on suprasegmental & music perception in India. The present study attempts to find the outcome of cochlear implanters perception skills. Measuring the suprasegmental features & music perception in different groups will helpful in finding outcome of cochlear implant.

Review of Literature

Speech comprised segmental features relating to the characteristics of the individual phonemes (vowels and consonants) and suprasegmental features such as intonation, stress, and emphasis, which are carried along the syllable, the utterance, or the sentence (Snow, 2001). The suprasegmental features of speech play a very important role in the process of understanding speech. They enable the listener to interpret the speaker's communicative intentions, such as differentiating a question from a statement or differentiating between a noun and a verb, as in the following case of syllable stress: 'object versus ob'ject. Thus, suprasegmental features are essential to the communication process (Borden, Harris, & Raphael, 1994).

Perception of suprasegmental features is accomplished through perception of the time–energy envelope of the speech signal and/or its fundamental frequency information. Listeners perceive a sentence's intonation mainly through the changes in fundamental frequency along the sentence. Along these changes, time and intensity aspects also change, serving as acoustic cues in the perception process (Cohen-Licht & Most, 2000; Grant, 1987; Most, 1985).

The perception of a sentence's syllable stress or word emphasis is also accomplished through the perception of the time– energy envelope of the speech signal and/or its fundamental frequency information. The stressed syllable (as in 'rebel vs. re'bel) or the emphasized word (as in Tom wants to drink vs. Tom wants to drink) is characterized by a higher fundamental frequency, longer duration, and greater amplitude in comparison to the same but unstressed syllable or unemphasized word (Borden et al., 1994). By using synthetic stimuli and controlling the changes of each of these parameters, researchers found that each of these comprised an effective perception cue (Fry, 1955; Isenberg & Gay, 1978).

For individuals with sensorineural hearing loss, the perception of intonation is considered as the most difficult of the suprasegmental features because it relies mainly on the perception of changes in fundamental frequency, which is not accessible to many individuals. Perception of the other features, on the other hand, relies mainly on the time–energy envelope, which is more accessible (Borden et al., 1994). Children with severe and profound hearing loss had more difficulties in the perception of yes/no questions, which are cued by a rising intonation contour, than in the perception of statements, which are cued by a falling intonation contour (Most & Frank, 1991). Also in an earlier study, Most (1985) reported successful perception of intonation even in children with profound hearing loss, provided they had received early and intensive intervention.

With regards to the perception of stress, some researchers (Jackson & Kelly, 1986) reported that individuals with hearing loss often experience difficulties in perceiving the stress pattern. Rubin-Spitz and McGarr (1986) found that participants with severe and profound hearing loss succeeded in perceiving the stress pattern only in those stimuli where the stressed and unstressed syllables differed in amplitude. In contrast, Most (2000) reported an 80.3% success rate in perceiving syllable stress among Hebrew speaking participants with

severe and profound hearing loss. She claimed that inasmuch as the perception of syllable stress relies mainly on the time–energy envelope of the speech signal, this feature should be relatively easy to perceive. Most attributed the participants' success in perceiving the stress pat- tern to the utilization of an appropriate and natural task, comprising meaningful sentences containing minimal pairs of target words that differed in their stress pattern.

The perception of word pattern (the number of syllables in a word) is considered to be very basic and accessible to most individuals, even those with pro- found hearing loss (Boothroyd, 1984; Geers & Moog, 1989). Using the Hebrew version of the Early Speech Perception battery (Geers & Moog, 1989), Kishon- Rabin et al. (2000) showed that children with pro- found hearing loss (poorer than 100 dBHL) had difficulties perceiving one-syllable words; however, they were able to perceive the word pattern.

Cochlear implant (CI) technology has opened up new rehabilitation options for spoken language use among individuals with severe and profound hearing loss. Many speech features that were not audible via the acoustic amplification of HA became audible via the electrical stimulation of the CI, thus improving the ability to perceive speech (Waltzman & Hochberg, 1990). Many studies that compared the perception of speech by children and adults using CI to those with similar hearing loss using HA showed the advantage of the CI over the hearing aid (Boothroyd & Eran, 1994; Blamey et al., 2001). However, most of these studies evaluated the perception of segmental features.

Much less research attention, however, has been given to the perception of suprasegmental features. Few studies examined the perception of suprasegmental features by participants with CI, and among these, some were conducted several years ago (e.g., Carney, Kienle, & Miyamoto, 1990; Waltzman & Hochberg, 1990), a possibly important factor when considering technological developments and modifications in Cochlear Implants.

In India due to less cochlear implant surgeries in last decades no studies attempted to check the suprasegmental features in cochlear implanters. By carrying out current study the suprasegmental features and music perception in cochlear implant candidates can be composed. This study can be used as reference in future studies.

Aim

To investigate the perception of Music and Suprasegmental features in adult with Cochlear implant and children.

Objectives

1) Compare the perception of pure-tone discrimination in CI children.
2) Compare the perception of environmental sounds in CI children.
3) Compare the perception of everyday sentences in CI children.
4) Compare the music perception (trumpet) in CI adult.
5) Compare the music perception (violin) in CI adult.

Methodology

I) Participants

A. Post lingual adult with Cochlear Implant

B. Pre lingual Cochlear Implant experienced users (More than 5-7 years of usage)

C. Pre lingual Cochlear Implant recent users (1 year completion of rehabilitation)

II) Selection criteria

A. Successful user of CI for past 5-7 years

B. Successful user of CI with completing one-year rehabilitation

C. Normal cognitive skills in assessment

D. Speech intelligibility (rating scale)

E. Speech perception skills (rating scale)

III) Stimulus

Angel SoundTM is a PC-based interactive listening rehabilitation program developed by TigerSpeech Technology and freely distributed by Emily Shannon Fu Foundation a non-profit organization. It helps in discriminating and identifying sounds and speech components through a series of self-paced modules that cover different aspects of the listening process. The level of difficulty is automatically adjusted to match developing listening skills. The program provides audio-visual feedback; highlighting areas we can continue to practice. Focused on practice and improvement of listening skills, Angel SoundTM compliments clinic rehabilitation and functional hearing test program.

(Retrieved from http://angelsound.emilyfufoundation.org/)

Angel SoundTM is an upgraded and free version of “Sound and WAY Beyond”, an auditory rehabilitation program based on CAST technology and distributed by Cochlear Americas. Angel SoundTM includes more advanced training protocols (i.e., bilateral training procedures, advanced psychophysical training protocols, animated audio and visual feedback, remote data access, and advanced training customization with favorite setting) than Sound and WAY Beyond. Also, Angel SoundTM has following modules

1) Basic Module
2) Noise Module
3) Telephone Module
4) Melodic Module
5) Open-set Module

6) Music Module
7) Auditory Module
8) Assess Module
9) Scene-based Module

In current research only two modules have been selected.

Basic Module

a) Pure Tone discrimination
b) Environment sounds
c) Everyday Sentences

Melodic Module

a) Trumpet
b) Violin

(Retrieved from http://angelsound.emilyfufoundation.org/)

IV) Procedure

Basic and Melodic modules will be selected for the current research. In basic module pure tone discrimination, environmental sounds and sentence recognition is selected for current research. The basic module is used for children with cochlear implant. In melodic module trumpet and violin is selected and presented for post-lingual adult with cochlear implant and pre lingual adult with Cochlear Implant (likely to be above 5-7 years of usage).

Expected Results

It is expected post-lingual adult with cochlear implant and pre lingual adult with cochlear Implant (More than 5-7 years of usage) to perform better compare to pre lingual children. In adults with cochlear implant usage durability is more compare to children. This

could be a main reason for better results. But in basic module children are expected to do equal to adults because of age factor.

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